Nirma University
School of Technology, Institute of Technology
B. Tech (Instrumentation and Control Engineering)

Semester VII

L	T	P	C
3	0	0	3

Course Code	2ICDE07
Course Title	System Estimation and Identification

Course Outcomes (CO):

At the end of the course, students will be able to -

1. explain system identification and estimation techniques
2. identify the model structure & order determination for an unknown process from empirical data
3. apply estimation techniques for parametric & nonparametric models
4. design and validate the model for practical process applications

Syllabus:	Teaching Hours

UNIT 1: Introduction 08

Introduction, Development of parameter estimators, Least-Squares estimation – linear least-squares, generalized least-squares, nonlinear least-squares, Sufficient statistics, Analysis of estimation errors, MMSE, MAP and ML estimators, sequential least-squares, asymptotic properties, General convergence results.

UNIT 2: System identification 10

Identification based on differential equations, Laplace transforms, frequency responses, difference equations. Stationary, auto-correlation, cross-correlation, power spectra. Random and deterministic signals for system identification: pulse, step, pseudo random binary sequence (PRBS), signal spectral properties, persistent excitation.

UNIT 3: Model Estimation and identification 10

Estimates of the plant impulse, step and frequency responses from identification data, Correlation and spectral analysis for non-parametric model identification, parametric Models-Equation error, output error models, and determination of model order.

UNIT 4: Methods of estimation and identification   12

Parametric estimation using one-step a head prediction error model structures and estimation techniques for ARX, ARMAX, Box-Jenkins, FIR, Output Error models. Residual analysis for determining adequacy of the estimated models. Recursive system identification.

UNIT 5: Nonlinear filters   05

Kalman filtering and other nonlinear filters

Self-Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. Arun K Tangirala Principles of System Identification: Theory and Practice, First Edition, CRC Press,2014
2. Karel J. Keesman, System Identification: An Introduction, Springer-Verlag London,2011
3. L.Ljung, System Identification: Theory for the User, 2nd Edition, Prentice-Hall,1999
4. Y.Zhu, Multivariable System Identification for Process Control, Pergamon,2001
5. T. Söderström and P. Stoica, System Identification, Prentice Hall International, Hemel Hempstead, Paperback Edition, 1994.
6. O.Nelles, Nonlinear System Identification, Springer-Verlag, Berlin,2001

L= Lecture, T= Tutorial, P= Practical, C = Credit